



NASA Langley Research Center

Systems Analysis Branch

Air Transportation System

Engineering & Analysis

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System-level Assessment of Operational Concepts, Technologies, and New Vehicles in the National Airspace System

- Framework for integrated systems analysis/engineering of air transportation system safety, capacity, economics, and environment
- Advanced aviation concepts/technology impacts on the integrated aviation system
 - Technical performance
 - Cost effectiveness
- New operational concepts and technologies with defined performance requirements that will have benefits across many scenarios
- Guidance on integration with and transition from current system to future system
- Technology investment portfolio guidance for best objective function solutions (e.g., risk, throughput, cost)
- Near, mid, and long-term time horizon

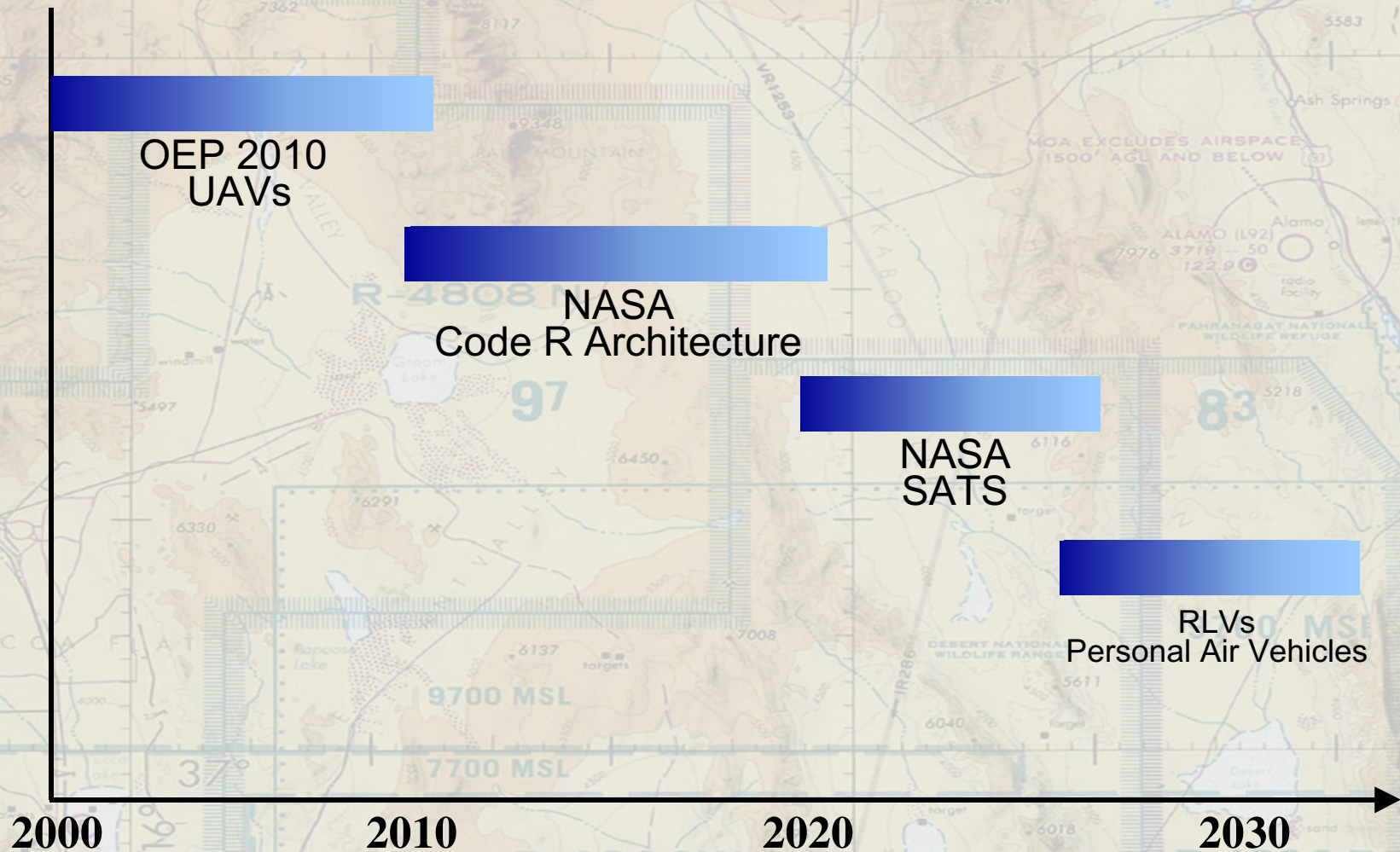


Programs, Organizations and Studies Supported

- Code R
 - Office of Aerospace Technology -- Investment Planning
 - Capacity and Mobility Goals
- Langley Research Center
 - Airborne Systems Competency
 - Small Aircraft Transportation System Program
 - Revolutionary Aerospace Systems Concepts Program
 - Safety Program
- Ames Research Center
 - Capacity Program
 - Virtual Airspace Modeling & Simulation Project



SAB ATS Engineering & Analysis Technology Time Horizon for Analysis





Solution Space - System Engineering and Analysis Simulation & Analytical Tool Suite

- “Closed Loop” Performance Simulation
 - AwSIM/Aeralib - Aerospace Engineering & Research Assoc.
 - CNS&D/L - Draper Laboratory
- Future ATM Concepts Evaluation Tool (FACET) - ARC
- Post Operations Evaluation Tool (POET) - FAA, AUA-700
- Reorganized ATC Mathematical Simulator (RAMS) - ISA
- Aviation System Analysis Capability (ASAC) - NASA/LMI



An Integrated Suite of New and Legacy Models

Flow or Network Models

E.g. LMINET

Level 1 - Policy Modeling
[Global or National]

Economic & Gross Estimates

E.g. ASAC Air Carrier
Investment Model

Level 2 - Low Fidelity Modeling
[National]

Microscopic Models

E.g. RAMS, AwSIM & SIMMOD

Level 3 - High Fidelity Modeling
[Regional]

Detailed Infrastructure Models

E.g. Full-fidelity performance
models of CNS systems

Level 4 - Infrastructure Resources
Performance Modeling

Detailed Human Performance

E.g. MIDAS

Level 5 - Human Performance
and Cognitive Modeling

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SAB ATS Engineering & Analysis Team Roles and Responsibilities

- **Systems Analysis Branch**

- Economics, demand, route structures, and airport/national-level queue models

- **Swales Aerospace**

- Overall simulation/model integration, operation and analytical support

- **Aerospace Engineering and Research Associates**

- Flight/Trajectory simulation, Conflict Detection & Resolution, and statistics

- **Draper Laboratory**

- Comm, Nav, Surveillance HW and Nav State simulation, airspace supply, and statistics

- **TeamVision**

- Model integration framework, multivariable sensitivity analysis/display capability

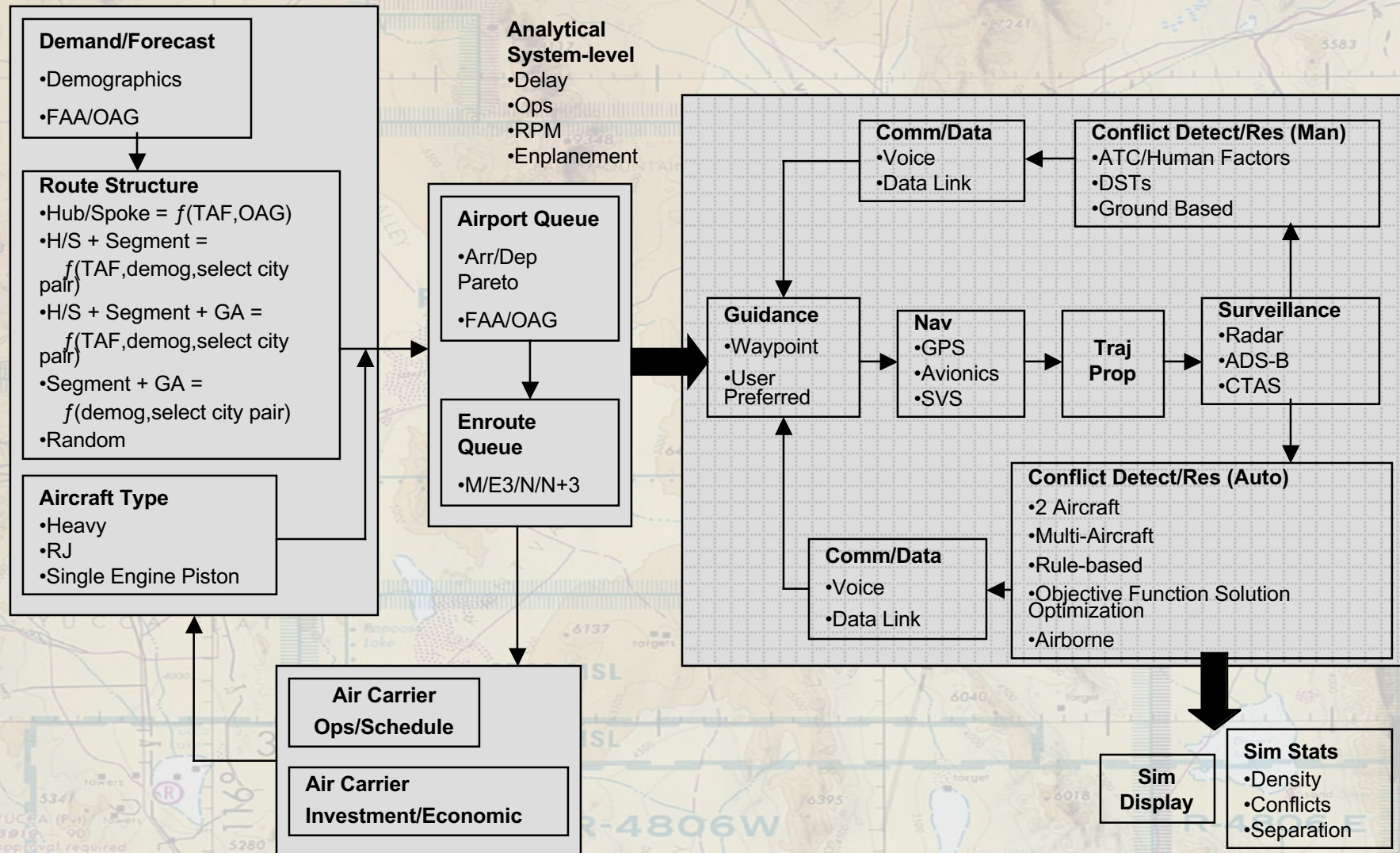
- **MIT/International Center for Air Transportation**

- Alternative concepts, key constraints, system non-linearity and dynamics, and decision making



SAB ATS Engineering and Analysis

Simulation, Models, and Display





SAB ATS Engineering and Analysis Schedule

Virtual Airspace Modeling & Simulation – Technical Interchange Meeting #2

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FY 02

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FY 03

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Post-Ops Evaluation Tool
Future ATM Concepts Evaluation Tool
Reorganized ATC Mathematical Simulation

Scenario Trials/Checkout

NASA/Swales

Dev/Integ/Test Closed Loop Sim

Draper/Aerospace/Swales

ASAC Test/Acceptance

NASA/LMI

Scenario Trials/Checkout

NASA/Swales

System Constraints/Non-linearities

MIT/Hansman



SAB ATS Engineering and Analysis Test & Validation

- ETMS/POET vs. AwSIM/Draper - Baseline
- DAG - TM 5
- DAG - TM 11
- Small Aircraft - Transition/Enroute



What's the Difference Between VAMS v. SAB Tasks?

- Beta test for VAMS
 - Subset of total VAMS scope
 - Work the details of tool/methods integration
 - Increase probability of VAMS success
- Total air transportation system analysis and impacts
 - Local/regional analyses
 - Rollup to system-level
- NASA in-house analysis line organization
 - Broad cross-section of customers and time horizons
 - Short term schedule needs
 - Multi-source funding leveraging



SAB ATS Engineering and Analysis WakeVAS Analysis

- Methods

- Previous Annual Goals Assessment of AVOSS technologies using ASAC airport/delay/enroute queuing models
- Add simulation
 - RAMS – terminal/local
 - AwSIM/Draper -- transition/enroute/system

- Scenarios

- Parallel and intersecting runways
- Departures and arrivals
- Dynamic spacing
- Valid time horizon -- scheduled v. unscheduled usage
- Multiple airports and OAG-based schedule/aircraft-type mix
- Multiple environment and aerodynamic conditions
- Boundaries/constraints of physical limitations



Solution Space -- System Engineering and Analysis Simulation & Analytical Components

- Demographic and FAA demand forecast
- Auto, Air Carrier and GA mode preference
- Origin & destination and route structure development
- Air transportation business, operations, and economics
- Terminal, enroute, and NAS capacity and delay
- NAS air traffic trajectory simulation
- Comm, navigation, surveillance and data infrastructure simulation
- Vehicle and air traffic management technologies and operations
- Multi-variable, sensitivity solution space analysis



Solution Space -- System Engineering and Analysis Functional Capabilities (e.g.)

- Integrated capacity, safety and economic tradeoffs
- Integrated local, regional & national NAS operations
- Performance impact of CNS, CDR & Data infrastructure components
- Non-controlled airport approach/departure scenario impacts
- Automated self-separation and self-sequencing
- GA/Air Carrier/Vertical Economics & Operations
- System requirements development and validation
- “Clean-sheet” traveler focused transportation system
- Multi-modal preference
- Integrated SATS/NAS flight demand and traffic assessment capabilities